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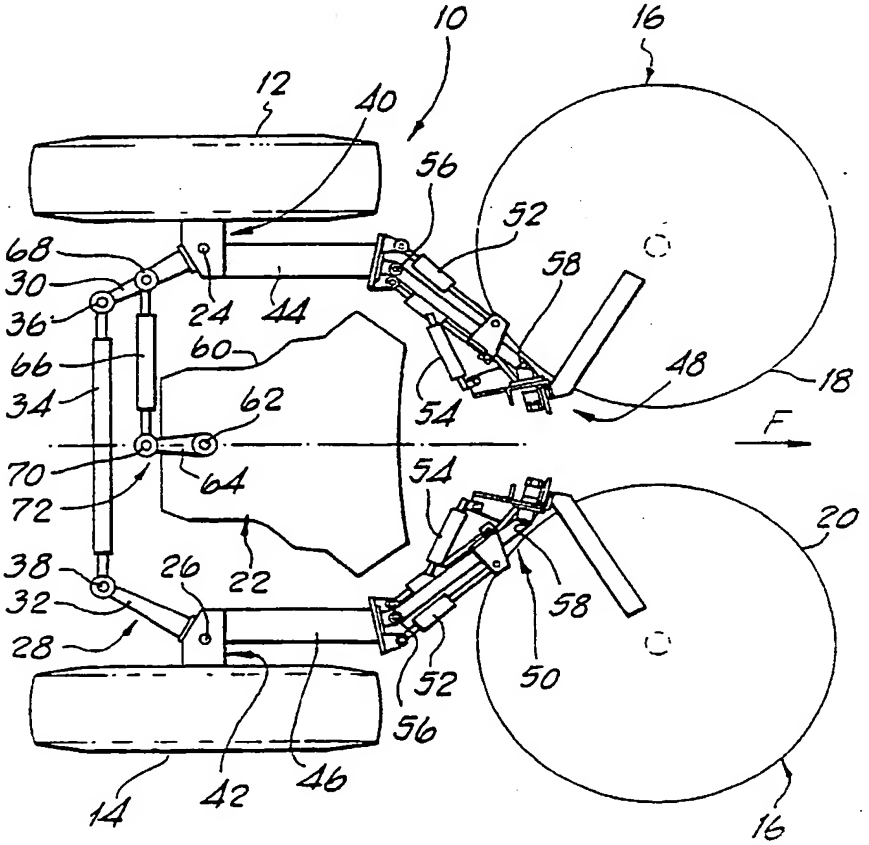
(57) Abstract

A cleaning vehicle (10), such as a self propelled road sweeper, has the suction nozzle (60) and brush gear (16) independently pivoted and steered in synchronism with the steered wheels (12, 14) of the vehicle. The relationship between the pivotal movement of the steered wheels (12, 14) and the nozzle (60) and brush gear (16) may be non-linear and different relationships may be chosen by selection of optional sweeping modes in a programmable control system (106) - all with a view to minimising unswept areas and improving control. Driver control of the basic position of the brush gear (16) is provided, including manual and automatic override for avoidance of obstructions.



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CLEANING VEHICLES

This invention relates to cleaning vehicles, for example such vehicles as disclosed in our International patent application published under serial number WO 87/01404. We hereby incorporate by reference the entire disclosure of our prior application into the present application.

In our prior application we have disclosed a cleaning vehicle in which the brush gear and the suction gear are both mounted on a support structure which is itself mounted for turning movement relative to the vehicle body. The support structure also carries the steerable wheels so that the entire assembly moves in unison. The matter inlet means or nozzle is located between the steerable wheels and the brush gear and nozzle and the steerable wheels turn as a single assembly, whereby their relative positions are unchanged during steering movements of the vehicle. This arrangement has significant advantages over prior proposals, as explained in our prior application. However, we have established that with this arrangement the problem can arise that when sweeping around a short radius corner it can happen that a strip of surface or ground is left unswept. This strip lies between the inboard edge of the zone swept by the inboard brush, and the outboard edge of the nozzle. The problem arises, at least in part, from the fact that the mounting of the brush gear is such that the inboard brush may need to be individually swung outwards about its pivot by the driver to enable the brush to maintain contact with the kerb or other curved edge being swept.

Further improvements which would be desirable in relation to the structure disclosed in our prior application relate to the steering mechanism itself and the inherently somewhat high loads arising in the steering gear and associated structures.

In GB 2 116 613B and EP 0087936B there is disclosed a cleaning vehicle incorporating a brush gear position control system having position sensing and feedback. In DE 35 17 079 there is disclosed a cleaning vehicle in which two sweeping brushes and a nozzle are mounted on a frame and form a sub-assembly which is pivoted on the vehicle body in unison with the steered wheels.

These latter prior art proposals suffer from such shortcomings as the aforementioned tendency to leave unswept areas at certain times, together with a limited ability to accommodate certain obstructions to sweeping which are encountered in use, and certain street layouts are found to be difficult. Moreover, the structure disclosed in the latter of these two prior specifications provides insufficient control over the brush gear due to the fact that the latter is not controlled directly, but only through the pivoted sub-frame. A further related factor concerns a tendency for this substantial pivoted sub-frame to be a cause of instability of the steered asembly of the nozzle and brush gear.

An object of the present invention is to provide a cleaning vehicle offering improvements in relation to one or more of the matters discussed above, or generally.

According to the invention there is provided a cleaning vehicle as defined in the accompanying claims.

In a prefered embodiment of the invention the suction nozzle or matter inlet means is pivoted independently of the brush mounting, and both these assemblies are steered in accordance with the steering of the steerable wheels of the vehicle. In this way different pivotal relationships as between the nozzle and the steered wheels, and the brush gear and the steered wheels can be achieved. These differing relationships enable the avoidance or substantial reduction of unswept areas or "trails" to be achieved. The relationship between the angular position of the steered wheels and the positions of the brush or brushes and the

nozzle may be non-linear. A different curve may be provided by the nozzle and the or each of the brushes. At any time, the driver can override the aforesaid relationship to provide independent brush control.

Whereas the arrangement disclosed in our prior International patent application and in DE 35 17 079 causes an alteration of the pivot position or mounting of the brush gear as the nozzle is steered, in the arrangement disclosed below there is more direct control of the brush gear position by direct actuation of the latter, as opposed to indirect actuation through a sub-frame. Thus, whereas the prior proposals steer two brushes and their mountings together with the associated nozzle in unison, the embodiments of the present invention merely steer one or more brushes and the nozzle independently whereby different relationships to the steered wheels can be achieved, such relationships being non-linear if desired and more than one such relationship being selectable, for example, by merely actuating a switch.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

Fig 1 shows a plan view of the steerable front wheels and assocaited brush gear and suction nozzle of a cleaning vehicle;

Fig 2 shows a second embodiment forming a modification of that of Fig 1; and

Fig 3 shows a modification of Fig 2.

As shown in Fig 1 a cleaning vehicle 10 comprises ground wheels including forward steerable wheels 12,14 and rear driven wheels (not shown) on which is mounted a vehicle body - also not shown. Vehicle 10 further comprises brush gear 16 having brushes 18 and 20, together with suction gear 22 in the form of a suction intake nozzle.

Apart from the structures described in detail below,

the entire structure and arrangement of vehicle 10 is as described in detail in our above-mentioned prior International application, to which reference is specifically directed for further information.

Steerable wheels 12,14 are mounted for pivotal movement about respective upwardly extending axes 24,26 and are interconnected by a steering linkage 28 comprising steering arms 30,32 interconnected by a steering link 34 and steering joints 36,38. A steering control system is provided to enable an operator of the vehicle to steer it in the conventional way from his cab. The steering system for the vehicle, described thus far, is very analogous to a conventional Ackermann vehicle steering system.

The brush gear 16 is mounted on the steered wheels 12,14 for steering movement in unison therewith. For this purpose, each brush 18,20 is mounted on its respective wheel axle assembly 40,42 through support arms 44,46 and brush mounting linkages 48,50. Linkages 48,50 are constructed substantially as described in our prior International application, to which reference is directed for all detailed information. Suffice it to say for present purposes that each linkage comprises hydraulic rams 52,54 which, together with a helical tension spring serve to control the linkages by means of a hydraulic system (not shown) including a valve under driver control. The driver can set the lateral position of each brush by causing pivotal movement of the assembly about an inner pivot 56 having an upwardly extending axis. Once the working position has thus been set, it is automatically maintained relative to the steered wheels 12,14 by the vehicle's steering system, as explained below. The linkage permits rearward yielding movement of its brush (with respect to direction F of vehicle forward motion) by pivotal movement about a forward upwardly extending articulation axis 58 against the action of the helical tension spring.

It can now be seen that as steerable wheels 12,14 turn about their steering axes 24,26 under the control of the driver's steering wheel, the brush gear 16 automatically moves with the wheels, by virtue of being supported on arms 44,46 and linkages 48,50. The drawing shows the brush gear in its inwardly stowed position for transport. During work, the brush gear is moved outwards by the driver to a selected working position by pivotal movement outwards about axes 56.

Turning now to the suction gear 22, this comprises a suction nozzle 60 constructed in a manner similar to that disclosed in our prior application and mounted for independent pivotal movement about an upwardly extending axis 62. A steering arm 64 is fixed to nozzle 60 so as to be able to steer it about axis 62. Steering arm 64 is connected to the steering arm 30 of steerable wheel 12 by a steering link 66 through steering joints 68,70. In this way, steering movement of wheels 12,14 by virtue of steering linkage 28 causes corresponding steering movement, in synchronism with the wheels, of nozzle 60 by virtue of the linkage 72 constituted by link 66, arm 64 and steering joints 68,70.

Control means is thus provided to control both the steerable wheels 12, 14 and the pivotal movement of the matter removal means comprising nozzle 60 and brush gear 16. Thus, the control means comprises the driver's steering control system for the wheels 12, 14, together with the linkage 72 and arms 44, 46 together with the brush mountings 48, 50.

In use, steering movement of wheels 12,14 to follow a selected sweeping path causes the brush gear 16 and nozzle gear 22 automatically to follow the vehicle's steering movements. It is particularly to be noted that the linkage 72 whereby suction gear 22 is steered is arranged to ensure that unswept areas between the inboard edge of the area swept by the inboard brush (say 18) and the outboard edge

of the area swept by nozzle 60 are minimised or eliminated. It will be readily appreciated that by suitably constructing linkage 72 it can be arranged that the nozzle and brushes pivot relative to the vehicle body with different relationships to the steerable wheels, so that for example, the angular movement of nozzle 60 is greater than that of the brush assemblies, whereby, even on sharp turns, the nozzle at least compensates for the need to individually swing, under driver control, the inboard brush in an outward direction relative to the inboard steered wheel, as the turn is executed.

In the embodiment of Fig 2, the general structure and arrangement is as described above in connection with Fig 1. Therefore, attention will be given mainly to the differences from the embodiment of Fig 1. In Fig 2, of the parts identified by reference numerals, those corresponding to the parts of Fig 1 are given the same reference numerals as in Fig 1.

In Fig 2, the principal differences from Fig 1 will now be described.

Firstly, brush mountings 48 and 50 are fixed at their inboard ends 100, 102 on the body 104 of vehicle 10. The point of attachment may be at any suitable location, and if the vehicle incorporates a resilient suspension, the point of attachment may be on the sprung or unsprung portion of the vehicle. Otherwise, the brush mountings 48 and 50 are substantially identical to those of Fig 1.

Nozzle 22 is pivoted about axis 62, as in Fig 1, but link 66 is not connected to steering arm 30. Instead, link 66 is connected to an operating mechanism (not shown) under the control of a programmable electronic control system indicated at 106. Controller 106 forms part of the control means in this embodiment, which corresponds to the mechanical link and mounting system interconnecting the brush gear and nozzle and steered wheels in Fig 1. In this embodiment, sensors 108, 110, 112, 114 and 116 are provided

on steered wheels 12, 14, and nozzle 22 and brush mountings 48 and 50 respectively. These sensors may be of any suitable form. For example, they may be in the form of potentiometers. The sensors feed signals back to the controller 106 through signal transmitting lines 118. The controller is arranged so that actuation of nozzle 22 and brush mountings 48 and 50 is effected in accordance with the degree of angular movement of steered wheels 12, 14 about their respective steering axes. In this embodiment, the lateral positions of the brush gear and the nozzle are controlled by hydraulic or pneumatic rams. The fluid control system for the rams incorporates a solenoid valve or valves. The valve control system may be generally on the lines disclosed in EP 0087936. Alternative systems for actuation and control of the nozzle and brush gear by means of the signals from sensors 108 to 116 may be provided.

In this embodiment, the controller 106 itself provides for a different pivotal relationship between nozzle 22 and steered wheels 12, 14, than there is between brush mountings 48 and 50 and the steered wheels. Controller 106 provides for variation of these angular relationships according to driver choice and/or sensed vehicle operational parameters. Thus, the one, two or more brushes and the nozzle can each have their own curve when steering angle of the wheels is plotted against the positions of the brushes and nozzle. Moreover, the brushes and nozzle can each have two or more such curves representing different and driver-selectable operational modes. These could be selected by, for example, the mere operation of a switch by the driver. In this way, the brush gear and nozzle are provided with flexible position control which is adaptable to operational requirements and emergencies while maximising sweeping efficiency and sweeping width while minimising the tendency to produce unswept areas and trails.

The driver's manual control system for the vehicle

includes a manual override control lever for the brush gear whereby he can position the brushes according to instantaneous requirements during vehicle travel. After such manual adjustment, once the brushes have been reset to a desired position, or else have been allowed to automatically reset thereto, the automatic control system takes over and maintains the proper relationship between brushes and nozzle and the vehicle body according to the selected operating programme of controller 106.

In the embodiment of Fig 3, the general arrangement and mode of operation is substantially as described above in connection with Fig 2. Simplified brush mountings 248 and 250 are provided, these being directly pivoted on the vehicle body at 252 and 254, and actuated by ram assemblies 256 and 258 respectively having angular movement sensors 257,259. Nozzle 260 is pivoted at 262 and actuated by a ram 264 and associated angular movement sensor 265. Steered front wheels 266, 268 are controlled by a ram 270 and associated angular movement sensor 271 acting on a steering link 272. A control system for the rams 256, 258, 264 and 270 and their sensors is provided as described above in connection with Fig 2. The vehicle is driven by rear wheels 272, 274 by means of an engine and transmission mounted on the vehicle body 276. Operation of this embodiment is substantially as described above in connection with Fig 2.

It will be appreciated that many modifications can be made in the above embodiments while remaining within the scope of the invention. Thus, for example, the invention is applicable to any suitable steering system for the vehicle which may be required.

Naturally, any suitable brush mounting linkage can be adopted according to the differing requirements of the above two embodiments, and otherwise. Such linkage can be provided with varying degrees of sophistication of control according to need, as disclosed above. In principle, in

the first embodiment above, only relatively simple control of the brush gear is strictly needed in view of its automatic steering control system arising from its mechanical connection to the vehicle steering system.

In the embodiments, the independent mounting of the brush gear and of the matter inlet means or nozzle permits differential rates of angular movement between the two as they turn with the steerable wheels. In the first embodiment, the brush gear moves exactly in unison with its respective steered wheel, by being mounted on the axle assembly thereof. This is not essential, as the second embodiment shows. An independent mounting with a linkage connection or other connection can also be envisaged. Likewise, the mechanical links direct to the steering system of the vehicle in Fig 1 can be replaced by hydraulic or other connections, as described in relation to Fig 2. In such a case, it can be readily provided that when steering control of the brush and/or matter inlet is not required, this can be dispensed with. In other words, the hydraulic or electronic and/or other connection could be arranged to be selectively rendered inoperable.

A third brush may be required for the vehicle in certain circumstances. Moreover, for certain operating conditions it may be necessary or desirable to control only one brush, or less than all the brushes at any given time.

Interestingly, the above embodiments, particularly those of Figs 2 and 3, provide notable advantages over the prior art. By avoiding the use of a pivoted sub-frame carrying the nozzle and brush gear mounted in a unitary mode, and by independently pivoting the nozzle and brush mounting or mountings, flexibility of operation is permitted. This enables better control of brush gear and nozzles. It avoids the uncertainty of the system disclosed in DE 35 17 079, in which the individual brush positions depend entirely on the resultant of the various dynamic forces acting on the brushes during use, including those

arising from the centralising return springs. By fixing the brush mounting arms to the vehicle body or chassis, the second embodiment is well adapted to be incorporated into exisiting sweeper designs with a minimum of structural modification. Indeed, the pivotal mounting of the nozzle then becomes the only major structural change included in the embodiment. The angular movement sensors are readily fitted to existing vehicle designs and the technology for such sensors is well established. The overall controller 106 will in most cases be electronic, with outputs to solenoid type valve control systems, and can incorporate existing brush gear control systems, such as disclosed in EP 0087936. Thus the embodiment provides a significant step towards total control of the brush and nozzle systems in a sweeping vehicle while requiring only modest changes to existing vehicle designs. Also, loads in the steering system are lower than in certain prior art proposals.

CLAIMS:

1. A cleaning vehicle comprising :

ground wheels including one or more steerable wheels ;

a vehicle body mounted on said ground wheels;

control means to control said steerable wheels;

matter removal means positionable in working relation to a surface to be cleaned, to remove matter therefrom;

said matter removal means comprising brush gear and matter inlet means and being mounted for turning movement relative to said vehicle body and being connected to said steerable wheels so as to turn relative to the vehicle body with said steerable wheels as the vehicle is steered;

characterised in that

said brush gear and said matter inlet means are mounted for independent turning movement under the control of said steering control means so as to turn relative to the vehicle body with the steerable wheels as the vehicle is steered.

2. A cleaning vehicle comprising:

ground wheels including one or more steerable wheels;

a vehicle body mounted on said ground wheels;

matter removal means positionable in working relation to a surface to be cleaned, to remove matter therefrom;

said matter removal means comprising at least one brush having an associated brush mounting, and matter inlet means, and said matter removal means being mounted for pivotal movement relative to said vehicle body; and

control means to control both said steerable

wheels and said pivotal movement of said matter removal means;
characterised in that:

said matter inlet means is mounted for pivotal movement independently of said brush mounting, whereby said matter inlet means and said brush mounting can pivot relative to said vehicle body with different relationships to said steerable wheels.

3. A cleaning vehicle according to claim 2 characterised in that said matter inlet means is mounted on said vehicle body between said steerable wheels for pivotal movement about its own upwardly extending pivot axis.

4. A cleaning vehicle according to claim 3 characterised in that said brush mounting comprises a brush mounting arm incorporating pivot means and fixed at its inboard end to said vehicle body.

5. A cleaning vehicle according to claim 4 characterised in that said control means itself interconnects said steerable wheels and said matter removal means and provides said difference in the pivotal relationships between said brush and said matter inlet means with respect to said steerable wheels.

6. A cleaning vehicle according to claim 5 characterised in that said control means comprises sensor means to sense steering movement of said steerable wheels and pivot control means to control pivotal movement of said brush mounting and of said matter inlet means in response thereto.

7. A cleaning vehicle according to claim 6 characterised in that said control means comprises programmable electronic means arranged to change the relationship of said pivotal movement of said matter inlet means and/or of said brush mounting with respect to the pivotal movement of said steerable wheels, according to

driver selected criteria or automatically sensed vehicle operating parameters.

8. A cleaning vehicle according to claim 7 characterised in that said control means comprises manually operable switch means and said driver selected criteria comprise two or more operational modes of said matter removal means which are selectable by the driver by manual operation of said switch means in which said relationships of said pivotal movement of said matter inlet means and of said brush mounting with respect to said steerable wheels differ from one mode to another, and said relationships being non-linear.

9. A cleaning vehicle according to claim 8 characterised in that said control means comprises manual override means whereby the driver can pivot the brush mounting to position the brush.

10. A cleaning vehicle according to claim 1 characterised in that said control means comprises pivotally connected links interconnecting said steerable wheels and said matter inlet means to effect said independent pivotal movement thereof.

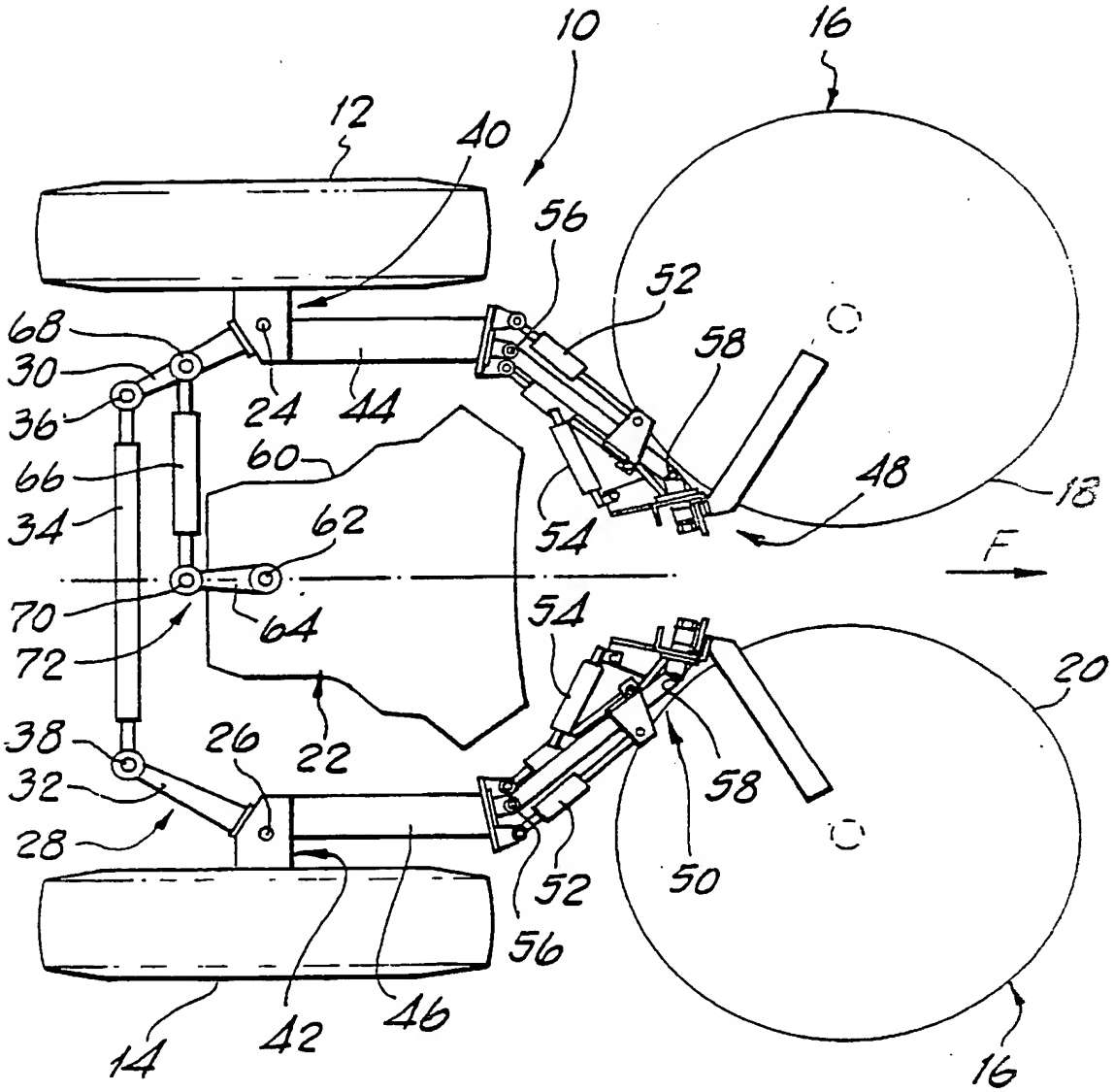
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FIG.1

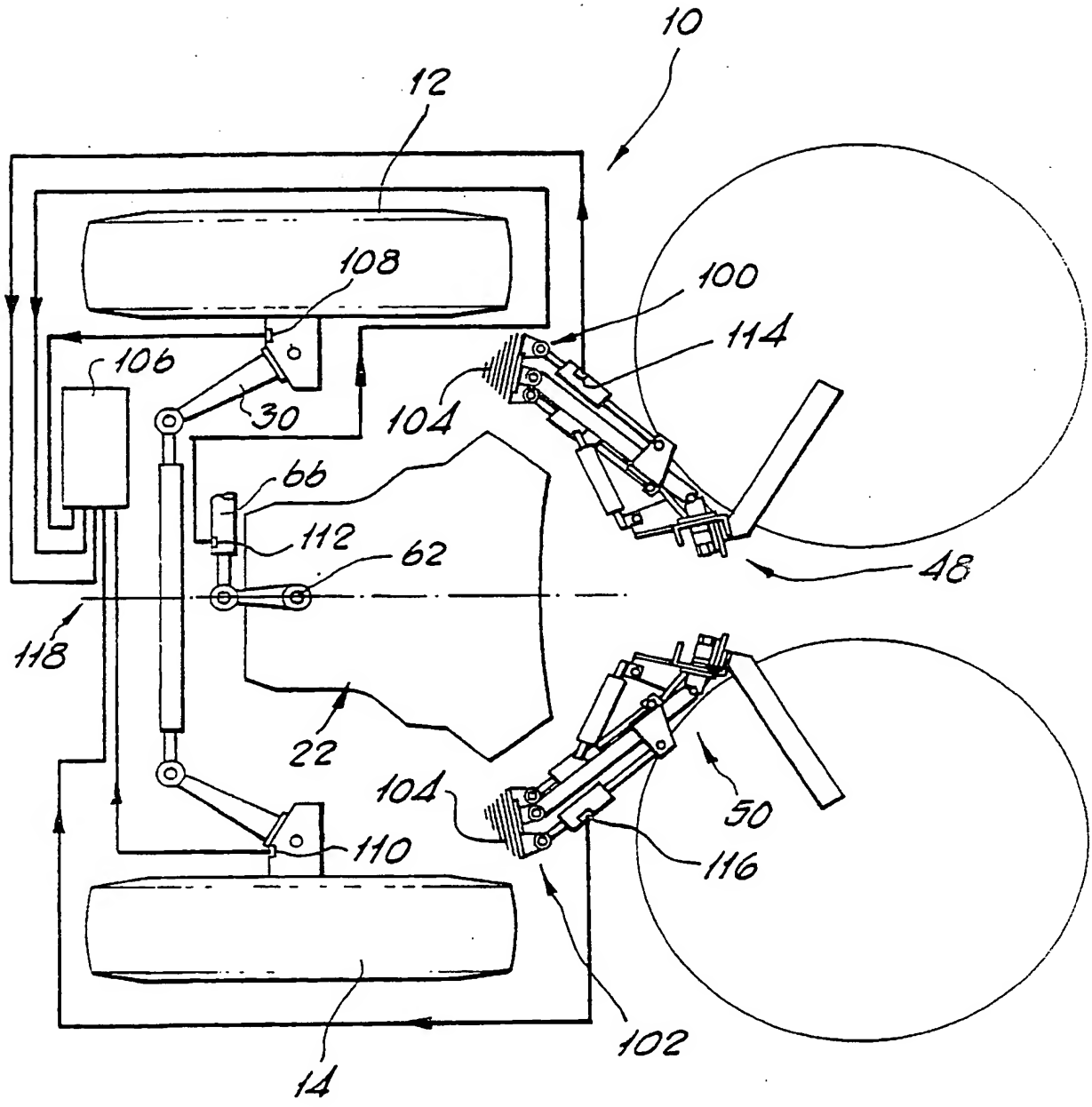

FIG. 2

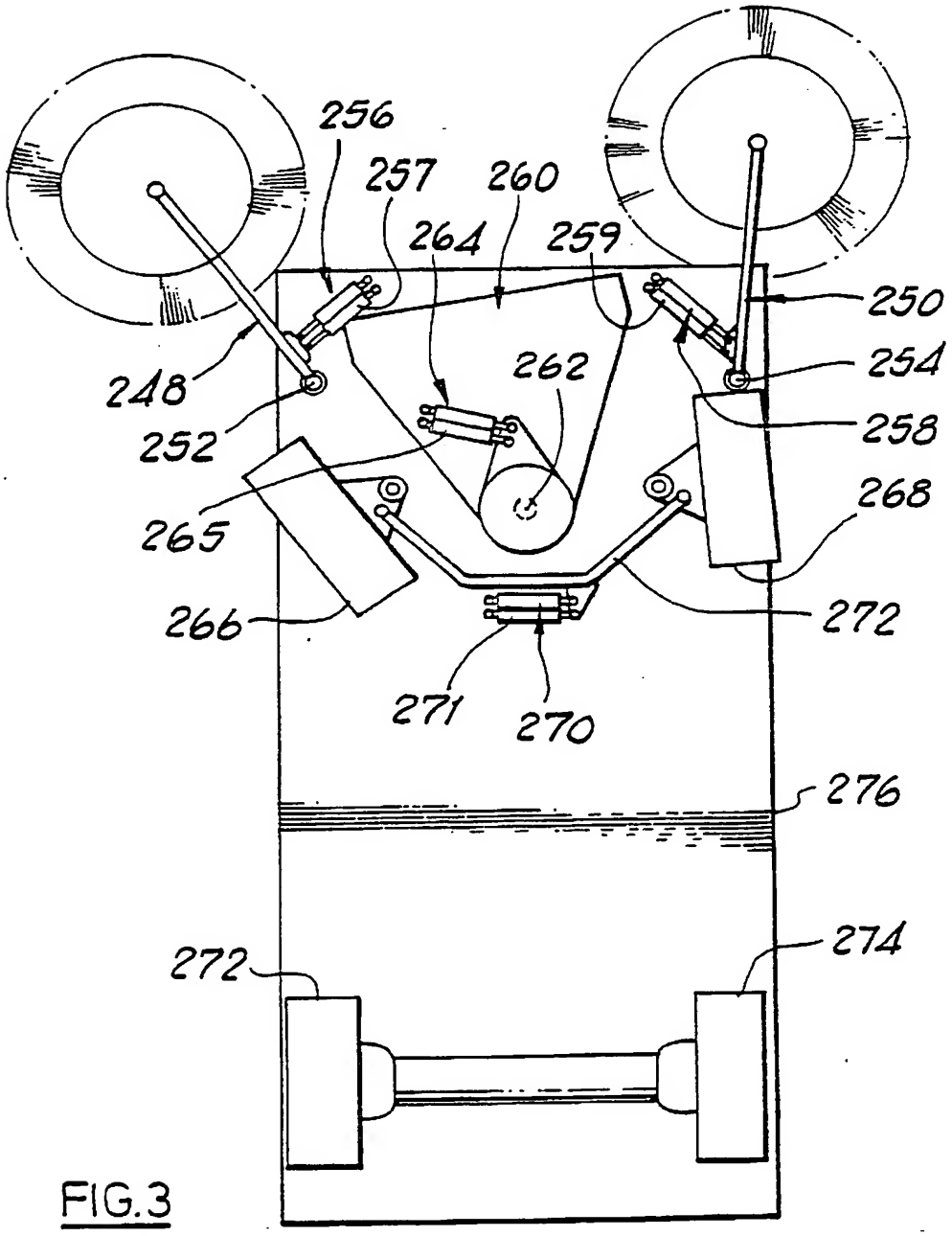

FIG.3

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 88/00439

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: E 01 H 1/08

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	E 01 H; A 01 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	WO, A, 87/01404 (DUNCAN VEHICLES) 12 March 1987 see the whole document cited in the application	1
A	DE, A, 3517079 (SCHORLING) 13 November 1986 see the whole document cited in the application	1
A	EP, A, 0087936 (SCHMIDT MAN.) 7 September 1983 see abstract; figure 2; page 9, line 10 - page 10, line 6 cited in the application	1

* Special categories of cited documents: [10]

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"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
30th August 1988	21 SEP 1988
International Searching Authority	Signature of Authorized Officer
EUROPEAN PATENT OFFICE	P.C.G. VAN DER PUTTEN

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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 8800439 SA 22782

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 12/09/88
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A- 8701404	12-03-87	AU-A- 6227786	24-03-87
		EP-A- 0269632	08-06-88
		JP-T- 63501647	23-06-88
DE-A- 3517079	13-11-86	None	
EP-A- 0087936	07-09-83	GB-A,B 2116613	28-09-83
		US-A- 4490874	01-01-85

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